



**CALIFORNIA STATE SCIENCE FAIR  
2007 PROJECT SUMMARY**

<b>Name(s)</b> <b>Magnus A. Haw</b>	<b>Project Number</b> <b>S0708</b>
<b>Project Title</b> <b>A Warming Earth: From the Chemistry of a Bench Experiment to Rigorous Statistical Analyses</b>	
<b>Objectives/Goals</b> My project determines whether recent warming in the Earth's atmosphere could be due to random climatic variability while also showing how carbon dioxide affects atmospheric temperature.	
<b>Abstract</b> <b>Methods/Materials</b> I downloaded temperature data from various meteorological sites for the period 1900-2005 for a sample of 16 cities around the globe and used statistical tests to determine whether the observed warming is statistically significant. The sample was designed to be representative of a variety of climates and regions of Earth. I also obtained data for annual days of frost, precipitation, and drought severity to observe how these parameters are changing. Other supporting data I examined over the same period were sea ice coverage (two areas), US hurricane frequency, atmospheric CO <sub>2</sub> concentration, solar flux, and global population. I used significance tests and regression statistics to analyze the trends and significance of temperature and annual frost days. I also performed a bench experiment where I illuminated a bell jar sample of CO <sub>2</sub> and a control jar and measured their equilibrium temperatures.	
<b>Results</b> All but one of the cities showed statistically significant warming over the past century (and the temperature of that city increased but was not significant). The statistical tests show that if the change was a random occurrence, an increase of two degrees C is highly improbable. The other climate data supports this trend: the number of annual frost days decreased at all sites, sea ice coverage decreased dramatically, and drought severity increased. The precipitation data showed no common trend. Atmospheric CO <sub>2</sub> concentrations increased exponentially correlating closely with population growth while solar flux remained in a stable periodic cycle. The results from the bench experiment show that air with a greater concentration of CO <sub>2</sub> has a greater greenhouse effect than unaltered air.	
<b>Conclusions/Discussion</b> My results show that recent increases in global and city temperatures are not due to chance and the warming is causal (caused by an external agent). Because CO <sub>2</sub> has rapidly increased and the bench experiment shows that greater concentrations of CO <sub>2</sub> will increase temperatures, my project suggests that an increasing human population with increasing CO <sub>2</sub> emissions is contributing to recent global warming.	
<b>Summary Statement</b> I statistically analyzed climate data to determine whether recent warming could be due to random climate variability; I also performed a bench experiment to show how carbon dioxide contributes to increases in temperature.	
<b>Help Received</b> Father made pins for globe model; Father and I discussed a new project title after the county fair; Math teacher suggested statistical program to shorten calculations (Minitab)	